ANNALS OF THE NEW YORK ACADEMY OF SCIENCES

Volume 456

November 26, 1985

MEMBRANE TRANSPORT DRIVEN BY ION GRADIENTS[a]

Editors and Conference Chairmen

GIORGIO SEMENZA and ROLF KINNE

CONTENTS

Preface. *By* GIORGIO SEMENZA and ROLF KINNE xi

Part I. General Aspects

Some Basic Aspects of Coupling in Secondary Active Transport. *By* Erich HEINZ 1

Stoichiometry of Cotransport Systems. *By* R. James TURNER 10

The Ubiquitous Presence of Channels with Wide Lumens and Their Gating by Voltage. *By* ALAN FINKELSTEIN 26

Gating of Large Toxin Channels by pH. *By* DAVID H. HOCH and ALAN FINKELSTEIN 33

Part II. Na^+ Symport Systems

Comments and Experiments on the Kinetics of Na^+ Gradient-coupled Glucose Transport as Found in Rabbit Jejunal Brush-Border Membrane Vesicles. *By* ROBERT K. CRANE 36

Different Temperature Sensitivity and Cation Specificity of Two Distinct D-Glucose/Na^+ Cotransport Systems in the Intestinal Brush-Border Membrane. *By* EDITH BROT-LAROCHE, M. A. SERRANO, BRIGITTE DELHOMME, and FRANCISCO ALVARADO 47

Sodium Cotransport Systems and the Membrane Potential Difference. *By* A. ALAN EDDY 51

The Potential Dependence of the Intestinal Na^+-Dependent Sugar Transporter. *By* GEORGE A. KIMMICH, JOAN RANDLES, DIEGO RESTREPO, and MARSHALL MONTROSE 63

Electrical Potential Dependence of Na^+-Sugar Cotransport Determined Using TPP^+ Influx. *By* DIEGO RESTREPO and GEORGE A. KIMMICH 77

The Characterization of Intestinal Acidic Amino-Acid Transport. *By* THERESA G. WINGROVE and GEORGE A. KIMMICH 80

[a]This volume is the result of a conference entitled Membrane Transport Driven by Ion Gradients held in New York City by the New York Academy of Sciences on October 1–4, 1984.

The Small-Intestinal Sodium-Glucose Cotransporter(s). *By* GIORGIO SEMENZA, MARKUS KESSLER, URSINA SCHMIDT, J. CRAIG VENTER, and CLAIRE M. FRASER 83

Biochemical Properties of the Na-D-Glucose Cotransport System in Renal Brush-Border Membranes. *By* JIANN-TRZUO LIN 97

Small Proteins Affect Na^+ Gradient-Dependent D-Glucose Transport in Isolated Renal Brush-Border Membrane Vesicles. *By* ADA ELGAVISH and ELIAS MEEZAN 101

Na^+-Dependent D-Glucose Transport in Brush-Border Membrane Vesicles of Chick Small Intestine: Relation to Na^+/H^+ Exchange and H^+ Permeability. *By* RENATE FUCHS, JÜRG GRAF, and MEINRAD PETERLIK 105

Sodium-Dependent Conformational Changes in the Intestinal Glucose Carrier. *By* ERNEST M. WRIGHT and BRIAN E. PEERCE 108

Kinetic Model of the Brush-Border Proline/Sodium (*IMINO*) Cotransporter. *By* BRUCE R. STEVENS and ERNEST M. WRIGHT 115

Conformational Changes in the Na/Proline Cotransporter of Intestinal Brush Borders. *By* BRIAN E. PEERCE and ERNEST M. WRIGHT 118

Alkali Cations, Freeze-thawing and Restitution of Na^+-Dependent Amino-Acid Transport Activity. *By* JOHN I. MCCORMICK and ROSE M. JOHNSTONE 121

Glycine Uptake in Pig Kidney Cortex Brush-Border Membrane Vesicles: Effect of Cl^-. *By* ANGELA CORCELLI, VITO SCALERA, and CARLO STORELLI 124

Electrophysiological Studies of Sodium Cotransport in Epithelia: Toward a Cellular Model. *By* STANLEY G. SCHULTZ, RANDALL L. HUDSON, and JEAN-YVES LAPOINTE 127

Glucose Transport in a Model of the Rat Proximal Tubule Epithelium. *By* ALAN M. WEINSTEIN 136

Cotransport Systems for Inorganic Sulfate and Phosphate in Small Intestine and Renal Proximal Tubule. *By* HEINI MURER, GREGORY AHEARN, MARTIN AMSTUTZ, JÜRG BIBER, COLIN BROWN, PIOTR GMAJ, BRUNO HAGENBUCH, KERSTIN MALMSTRÖM, INGVILD MOHRMANN, MATTHIAS MOHRMANN, and GERTRAUD STANGE 139

Ion-coupled Neurotransmitter Transport across the Synaptic Plasma Membrane. *By* BARUCH I. KANNER and RODICA RADIAN 153

Part III. Na^+, K^+, Cl^- Cotransport; H^+, Na^+ Antiport; Volume Regulation

Musings on the Role of Ion Transport on Cell Volume Regulation. *By* ASER ROTHSTEIN 162

$Na^+ + K^+ + 2\ Cl^-$ Cotransport in Animal Cells—Its Role in Volume Regulation. *By* PETER GECK and BARBARA PFEIFFER 166

The Duck Red Cell Model of Volume-Sensitive Chloride-Dependent Cation Transport. *By* THOMAS J. MCMANUS, MARK HAAS, LAWRENCE C. STARKE, and CHRIS Y. LYTLE 183

Na-K-Cl Cotransport in Chloride-transporting Epithelia. *By* FRANKLIN H. EPSTEIN and PATRICIO SILVA 187

The Role of NaCl-KCl Cotransport System in Active Chloride Absorption and Secretion. *By* R. KINNE, J.A. HANNAFIN, and B. KÖNIG 198

Regulation of Na^+/H^+ Exchange in Lymphocytes. *By* S. GRINSTEIN, J. D. GOETZ, S. COHEN, A. ROTHSTEIN, and E. W. GELFAND 207

Properties of the Renal Na^+-H^+ Exchanger. *By* PETER S. ARONSON 220

Regulation of the Activity of the Na^+-H^+ Antiporter in Brush-Border Membrane Vesicles from the Proximal Tubule. *By* ANDREW LOWE, HERBERT Y. LIN, VICTORIA J. YEE, and DAVID G. WARNOCK 229

Relative Rates of Na^+-H^+ and Cl^--OH^- Exchange Reactions in Isolated Intestinal Cells. *By* MARSHALL H. MONTROSE and GEORGE A. KIMMICH ... 232

Ion Extrusion Systems in Bacteria. *By* BARRY P. ROSEN, SURESH V. AMBUDKAR, MIGUEL G. BORBOLLA, CHIH-MING CHEN, HUO-SHU HOUNG, HARRY L. T. MOBLEY, HIROSHI TSUJIBO, and GARY W. ZLOTNICK 235

Anion Exchange in Bacteria: Variable Stoichiometry of Phosphate: Sugar 6-Phospate Antiport. *By* PETER C. MALONEY and SURESH V. AMBUDKAR .. 245

Potassium-Dependent Amino-Acid Transport in Lepidoptera. *By* V. CAPRARO, B. GIORDANA, G. M. HANOZET, P. PARENTI, and V. F. SACCHI 248

Sodium-Calcium Exchange across the Synaptic Plasma Membrane. *By* DONALD L. GILL, TERUKO UEDA, and SHEAU-HUEI CHUEH 250

Part IV. H^+-Symport Systems

Coupling of H^+ Gradients to Catecholamine Transport in Chromaffin Granules. *By* R. G. JOHNSON, S. E. CARTY, and A. SCARPA 254

The Amine Transporter from Bovine Chromaffin Granules. *By* SHIMON SCHULDINER, RUTH GABIZON, RON MARON, RAUL SUCHI, and YAEL STERN 268

Serotonin Transport by Platelet Plasma and Granule Membranes. *By* GARY RUDNICK, CYNTHIA J. HUMPHREYS, and GARY E. DEAN 277

Principles of Carrier Catalysis Elucidated by Comparing Two Similar Membrane Translocators from Mitochondria, the ADP/ATP Carrier and the Uncoupling Protein. *By* MARTIN KLINGENBERG 279

Structural and Functional Asymmetry of the ADP/ATP Carrier from Mitochondria. *By* REINHARD KRÄMER and MARTIN KLINGENBERG 289

Proton Electrochemical Gradients and Active Transport: The Saga of *lac* Permease. *By* H. R. KABACK 291

Topology of the *lac* Permease Protein in the Membrane of *Escherichia coli*. *By* N. CARRASCO, D. HERZLINGER, S. DECHIARA, W. DANHO, and H. R. KABACK 305

Site-directed Mutagenesis of the *lacY* Gene of *Escherichia coli*. *By* P. V. VIITANEN, H. K. SARKAR, D. MENICK, W. R. TRUMBLE, E. PADAN, W. MCCOMAS, M. POONIAN, and H. R. KABACK 307

Topological Studies of Lactose Permease of *Escherichia coli* by Protein Sequence Analysis. *By* BARBARA BIESELER, HEINRICH PRINZ, and KONRAD BEYREUTHER 309

Lactose: H^+ Carrier of *Escherichia coli*: Kinetic Mechanism, Purification, and Structure. *By* J. K. WRIGHT, K. DORNMAIR, S. MITAKU, T. MÖRÖY, J. M. NEUHAUS, R. SECKLER, H. VOGEL, U. WEIGEL, F. JÄHNIG, and P. OVERATH 326

Melibiose-Cation Cotransport System of *Escherichia coli*. *By* TOMOFUSA TSUCHIYA, DOROTHY M. WILSON, and T. HASTINGS WILSON 342

Isolation, Characterization, and Nucleotide Sequences of Lactose Permease Mutants That Have Acquired the Ability to Transport Maltose. *By* ROBERT J. BROOKER and T. HASTINGS WILSON 350

Myo-Inositol Transport in Bacteria: H^+-Symport and Periplasmic Binding Protein Dependence. *By* JACQUES P. M. DESHUSSES 351

The Role of Electron Transfer and Dithiol-Disulfide Interchange in Solute Transport in Bacteria. *By* M. G. L. ELFERINK, K. J. HELLINGWERF, J. M. VAN DIJL, G. T. ROBILLARD, B. POOLMAN, and W. N. KONINGS 361

Primary and Secondary Transport of Cations in Bacteria. *By* FRANKLIN M. HAROLD and YOSHIMI KAKINUMA 375

Part V. Genetics and Regulation of Cotransport Systems

Genetics and Mammalian Transport Systems. *By* CHARLES R. SCRIVER and HARRIET S. TENENHOUSE 384

Isolation and Culture of Murine Renal Proximal Tubule Cells: A System to Study Solute Transport in Mutants. *By* C. L. BELL, H. S. TENENHOUSE, and C. R. SCRIVER 398

Cultured Human Fibroblasts and Plasma Membrane Vesicles to Investigate Transport Function and the Effects of Genetic Mutation. *By* JANET A. BUCHANAN, DAVID S. ROSENBLATT, and CHARLES R. SCRIVER 401

Regulation and Genetics of Amino-Acid Transport. *By* DALE L. OXENDER, ELLEN J. COLLARINI, MARK A. SHOTWELL, CARMEN D. LOBATON, ALFREDO MORENO, and GEORGE S. CAMPBELL 404

Gene Transfer and Cloning of the Amino-Acid Transport System L from Human Cells. *By* M. RAAFAT EL-GEWELY and DALE L. OXENDER 417

Development of Na^+-Dependent Hexose Transport in Cultured Renal Epithelial Cells ($LLC\text{-}PK_1$). *By* ELLEN R. WEISS, KURT AMSLER, W. DAVID DAWSON, and JOHN S. COOK 420

Regulation of the Sodium-coupled Glucose Transport by Glucose: Protein Synthesis Dependence. *By* A. MORAN and M. HAGAN 436

Hormonal Effects on Sodium Cotransport Systems. *By* B. SACKTOR and J. L. KINSELLA 438

Further Studies of the Effect of Thyroid Hormones on Na^+-H^+ Exchange in Renal Brush-Border Membrane Vesicles (BBMV). *By* J. L. KINSELLA, T. CUJDIK, and B. SACKTOR 445

Renal β-Hydroxybutyrate (βOHB) Transport in Streptozotocin (Sz)-Induced Diabetic Rats. *By* L. CHENG, S. EL-SEIFI, and B. SACKTOR 448

Biologic Regulation of Na/H Antiporter Activity in a Cultured Kidney Cell Line: Effects of Parathyroid Hormone (PTH). *By* A. S. POLLOCK, G. J.

STREWLER, R. T. MILLER, D. LAWLOR, D. D. HOROWITZ, and D. G. WARNOCK 451

A New Na^+-Independent Transport System for Dipolar Amino Acids Apparently Corresponding to Systems Persisting after Erythrocyte Maturation in Some Mammalian Genotypes. *By* JAYDUTT V. VADGAMA and HALVOR N. CHRISTENSEN 454

Glucose and Sodium Transport in Brush-Border Membrane Vesicles from Fetal Rabbit Kidney. *By* JEANNE C. BECK 457

Index of Contributors 461

Financial Assistance was received from:

- BAYER AG/MILES LABORATORIES
- BRISTOL-MYERS COMPANY/PHARMACEUTICAL RESEARCH AND DEVELOPMENT DIVISION
- CIBA-GEIGY CORPORATION
- FOGARTY INTERNATIONAL CENTER—NATIONAL INSTITUTES OF HEALTH
- HOECHST-ROUSSEL PHARMACEUTICALS, INC.
- HOFFMANN-LA ROCHE INC.
- LILLY RESEARCH LABORATORIES
- MERCK SHARP AND DOHME RESEARCH LABORATORIES
- NATIONAL INSTITUTE OF ARTHRITIS, DIGESTIVE AND KIDNEY—NATIONAL INSTITUTES OF HEALTH
- THE NEW YORK EPITHELIAL TRANSPORT SOCIETY
- A. H. ROBINS COMPANY
- SCHERING CORPORATION
- SMITH KLINE BECKMAN CORP.
- STUART PHARMACEUTICALS/DIVISION OF ICI AMERICAS, INC.
- U.S. OFFICE OF NAVAL RESEARCH

The New York Academy of Sciences believes it has a responsibility to provide an open forum for discussion of scientific questions. The positions taken by the participants in the reported conferences are their own and not necessarily those of The Academy. The Academy has no intent to influence legislation by providing such forums.